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GEOLOGY:—*Review of Dr. Günther Schlesinger's paper on Mastodons.*
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In a paper published¹ in 1912 Dr. Günther Schlesinger presented a classification of the mastodons, proceeding on the theory that they all belonged to one genus, but that subgenera were indicated. He expressed his indebtedness to a friend for instruction in the laws of nomenclature and of priority; and this instruction led him to adopt for all mastodons Cope's generic name *Tetrabelodon*. It rendered him also competent to join in a protest² against the strict application of the law of priority. Inasmuch as in that paper under his subgeneric names, Schlesinger cited species only as examples, not choosing types, consideration of these subgenera will be passed.

In his recently published³ essay Schlesinger presents a similar scheme of classification, but with some changes. He disavows his former choice of *Tetrabelodon* on the ground that its use was not, after all, in accordance with the rules of nomenclature, and he now places the generic primacy on *Mastodon*. He also selected a type species for each of his subgenera.

In choosing *Mastodon* as the generic name Schlesinger grants that there is no valid reason why *Mammut* should not be employed; but he rejects it on the ground that, being used in German literature as a name for the Siberian elephant, confusion would result. For the same reason, one may think, our modern Greek zoologists and paleontologists might object to the use of *Hipparion* for a three-toed horse, whereas they apply it to the existing one-toed equine; also to the use of *Corydalus* for a neuropter insect, whereas it is the modern Greek word for the sky-lark.

¹ Jahrb. geolog. Reichsanst. Wien, 62: 135.

² Ziegler, Zool. Anz., 33: 263.

³ Denkschr. naturh. Staatsmus., 1: 1. 1921.

Mammut, however, is not wholly shorn of authority. It is simply required to take a less conspicuous seat and is there permitted to preside over *Mastodon americanus* and its near kin. Being retained in a somewhat obscure position, it is less likely to be mistaken for an elephant. *Tetrabelodon* likewise has suffered a reduction in rank and now represents only *Mastodon pygmaeus* Depéret. Inasmuch as *M. pygmaeus* had not been heard of by Cope when he established *Tetrabelodon*, much less included under the name, it cannot be made the type of this genus. Besides, Cope expressly stated that the type of *Tetrabelodon* is *T. angustidens*.

It may be well to point out here again, as the writer has already done,⁴ that the oldest generic name for *angustidens*, if withdrawn from *Mastodon*, is *Gomphotherium*; that the oldest specific name is *leptodon*,⁵ and that hence the species is properly to be known as *Gomphotherium leptodon* Fischer de Waldheim; and the name will, in this paper, be used for the species. In Schlesinger's scheme this species is recognized as the type of Vacek's genus *Bunolophodon*. Already, in 1918, Dr. W. D. Matthew⁶ had made *angustidens* the lectotype of this genus; a lucky stroke, inasmuch as *Bunolophodon* became thereby a synonym of *Tetrabelodon*, therefore of *Gomphotherium*, and hence apparently permanently side-tracked.

For *Mastodon arvernensis* Dr. Schlesinger proposes a new subgenus *Dibunodon*. This appears superfluous, however, inasmuch as *Anancus* presents claims for the honor. This name was first used in 1854 by Aymard⁷ for a mastodon called *Anancus macropus*, but there was no description, and the name was a dead letter. The writer has recently explained⁸ the status of this name. Suffice it to say that if *Mastodon arvernensis* requires a generic or subgeneric name *Anancus* must be used, credited to Lartet, 1859. Moreover, it must include all other mastodons not withdrawn on valid generic characters.

For the type of Cope's genus *Dibelodon* Schlesinger proposes *Mastodon humboldtii*, but Cope at the time of establishing this genus made Leidy's *M. shepardi* the type. Unless it can be shown that this species is a synonym of *M. humboldtii*, which would appear to be a task beset with difficulties, Schlesinger's proposal will hardly be

⁴ Pan-Amer. Geol. **39**: 109. 1923.

⁵ Op. cit., p. 112.

⁶ Bull. Amer. Mus. Nat. Hist. **38**: 200. 1918.

⁷ Ann. Soc. Agric. Sci. du Puy, **19**: 597. 1854.

⁸ Proc. U. S. Nat. Mus., vol. 66, art. 35, p. 4, 1925.

accepted by people who have any regard for established rules of nomenclature. The genus *Dibelodon* was based on a tusk and a tooth, but nobody can at present be certain that these belonged to the same species or even genus, and the probability appears⁹ to be that there were long tusks in the lower jaw. This, however, does not necessarily put the species in the genus *Gomphotherium*, as was wrongly concluded by the present writer on the page quoted.

Schlesinger's use of *Mastodon tapiroides* as a type of *Zygalophodon* appears to be legitimate. It seems to have been selected by Matthew¹⁰ in 1918. Schlesinger makes *Mastodon pentelici* the type of his *Choerolophodon*. The animal appears really to belong to a distinct genus, not so much on account of its teeth, perhaps, as of its remarkable skull.

Without any desire to question Dr. Schlesinger's knowledge of proboscideans, it seems necessary to say that that author has no proper conception of the significance of a genotype. When once properly chosen and announced, it should be inseparably joined to its genus, but the writer here reviewed evidently regards it as possible to detach that species and attach it as type to any other genus that may suit his wishes. If he does not so regard a genotype, how can he make *pygmaeus* the type of *Tetrabelodon* when Cope said Cuvier's *angustidens* was to be taken as the type? Practices of this kind tend to produce confusion in biological nomenclature.

In pursuing his theme Dr. Schlesinger pays his respects to some of the primitive mastodons of America. One finds it difficult to determine what he has in mind when he writes about *Mastodon shepardi*. When he mentions *M. obscurus* he evidently refers to the tooth described by Leidy from California, first as *M. shepardi*, later as *M. obscurus*. These are different species, one found on the eastern border of the continent; the other, on the western. He likewise makes the mistake of attributing Cope's type of *M. productum* (= *Gomphotherium productum*) to Mexico, instead of New Mexico.

It might be regarded as improbable that, starting at any point between France and New Mexico, any species of proboscidean would not in its journey to the two countries undergo specific modifications. Among living mammals it is rare to find the same species in southern Europe and the southern United States. Schlesinger finds it other-

⁹ Hay, O. P., Pan-Amer. Geol., 39: 111. 1923.

¹⁰ Bull. Amer. Mus. Nat. Hist., 38: 200. 1918.

wise. He assures us that he cannot distinguish Cope's *Gomphotherium productum* from *G. leptodon* "forma typica," and that Leidy's *M. obscurus* represents "forma subtapiroidea."

Dr. Schlesinger discovers much to complain of in Cope's description of *G. productum*. He finds fault with Cope's expression regarding the cross-section of the tusk. Cope quoted Falconer's statement that the symphyseal tusks of *Gomphotherium leptodon* frequently have a channel on the superior and inner sides and then he wrote: "In *M. productus* the tusk is without channel." Schlesinger says that this is an error of Cope's; but he himself is wrong in that he supposes that Cope referred to the fine longitudinal channeling which the ivory shows when the smooth outer layer is removed. Cope, however, had in mind the broad shallow channel or groove which is present on the upper surface of the lower tusk of *Gomphotherium leptodon*. If Schlesinger's section is compared with that figured by Cope¹¹ it will be seen that he was correct and that the tusks described by him are quite different in section from those figured by Schlesinger. That Cope observed what Schlesinger calls "kannelierung" is shown by Cope's statement: "The dentine is longitudinally, weakly, closely striate. It is usually covered by a thin layer of cementum."

Schlesinger questions Cope's statement that the symphysis of his *G. productum* was shorter than that of *G. leptodon*. In Cope's figure,¹² as noted by Schlesinger, it is seen that a part of the bone is restored in plaster, and Schlesinger concludes that the jaw has been wrongly restored and was originally much longer. But Schlesinger could not see whether there was natural contact between the two parts on the lower side or in the interior. Why, then, his confident conclusion? As a matter of fact, the present writer finds nowhere actual contact superficially between the proximal and the distal halves of the symphysis. What is hidden beneath the surface is unknown. Nevertheless, the conformation of the parts indicates that no important gap was closed up. The concave and the convex surfaces of the basal portion of the symphysis pass in a natural way into the corresponding surfaces of the anterior part. At least, nobody has the right to say positively that the symphysis has, in the middle of the length, been artificially shortened. Furthermore, if Schlesinger means to say that the front end of the symphysis as figured by Cope is not the natural termination, he is wholly mistaken. The bone ends as represented. Schlesinger likewise attacks the position of the two lower tusks of Cope's specimen and states that these must have been, in life, closely

¹¹ Wheeler, U. S. Geogr. Sur. west 100th merid., vol. VI, pl. LXX, fig. 3.

¹² Op. cit., pl. LXX, figs. 1-3.

applied, one against the other, as they are in *G. leptodon*; whereas in the restoration they stand apart about 15 mm. This is another error. The two teeth are separated by 12 mm. of bone thoroughly fossilized and never disturbed, and the symphysis has its natural width, 120 mm. Again, there is nothing either in the description or in the restoration of the specimen to indicate that Cope did not know that the lower incisors extend far back into the jaw. When he fitted the two parts of the symphysis together he could not help seeing this. Besides, on his page 307, Cope speaks of the longitudinal concavity on the underside of the beak "which occupies the space between the alveolar ridges of the enclosed tusks."

In the U. S. National Museum is the lower jaw which Leidy described¹³ in 1873. In this jaw are both lower tusks, and these have exactly the same oval section as those of Cope's type. Cope was aware of Leidy's specimen and the description, and knew, therefore, that the tusks extended backward to near the hinder end of the symphysis. One tusk is exposed nearly its whole length. It must be said further that throughout their length these tusks are separated by a septum of bone 14 mm. thick.

That the symphyseal portion of the jaw of *G. productum* is not the same as in *G. leptodon* is shown by the proportions of the parts. In *G. leptodon* the anterior mental foramen is placed much farther forward than in *G. productum*, as shown both in Cope's and Leidy's specimens. According to Schlesinger's restoration of the lower jaw of *G. leptodon*, the greatest width near the distal end is only 0.265 of the distance from the distal end to the anterior mental foramen; in Cope's type the corresponding value is very close to 0.5; in the symphysis described and figured by Leidy the value is close to 0.4. A computation based on Leidy's specimen shows that Cope's type was not shortened more than 25 or 30 mm., if at all. The difference may be due to individual or sexual variation. In other respects the symphyseal portion of the jaw of *Gomphotherium productum* is quite different from that of *G. leptodon*. In the latter, this part is relatively long, slender, constricted in the middle of the length, and spatulate at the distal end. In *G. productum* the part is broader in proportion to the length and its right and left borders are nearly parallel. In *G. leptodon* the length of the tooth row, M_1-M_3 following Schlesinger's restoration, is two-thirds the length of the symphysis. The tooth row of Cope's type, M_2-M_3 , lacks little of equalling the symphyseal length of Leidy's specimen, and it is to be remembered that this

¹³ Extinct Vert. Fauna West. Terrs., p. 235, pl. XXII, figs. 1-4.

belonged to a larger animal. In the type the beak-like lower jaw is much more bent downward than it is in *G. leptodon*. Cope gives the amount of deflection as 35°. This seems to be measured in the upper border of the beak.

Dr. Schlesinger tells us that the teeth of Cope's type of *G. productum* are indistinguishable from those of *G. leptodon* "forma typica." To the present writer they appear distinctly different. At hand is a fine specimen of the lower left hinder molar of *G. leptodon* sent from southern France by Lartet. It is in nearly the same stage of wear as the corresponding tooth of Cope's type. The two teeth have the following dimensions:

TABLE 1.—MEASUREMENTS OF THIRD LOWER MOLARS IN MILLIMETERS

	G. LEPTODON	G. PRODUCTUM
Length.....	157	158
Width at second crest.....	68	75
Height of first posttrite cone.....	50	75
Height of second posttrite cone.....	50	65
Height of third posttrite cone.....	53	55
Height of fourth posttrite cone.....	38	45

In these measurements allowances are made as carefully as possible for loss by wear and injury. The height of the cones is measured perpendicularly to the base of the crown, not along the slopes.

The lower third molar of *G. leptodon* is narrow and has relatively low crests and the first three are of nearly the same height. In *G. productum* the tooth is broad and has high crests which diminish in height from the first to the last, as shown by figure 3 on Cope's plate LXXI. In *G. leptodon* the principal cones, especially the outer ones, are columnar and broadly rounded at the summits; in *G. productum* they are conical and their summits are narrow. In the specimen of *G. leptodon* at hand the second lower molar lacks its front crest. Its width at the third crest is 60 mm. In *G. productum* this molar is 102 mm. long, 75 mm. wide at the rear, and 60 mm. in front. The teeth of *G. productum* had reached a higher stage of development than those of *G. leptodon*.

Dr. Schlesinger is no doubt correct in his identification of the upper teeth figured¹⁴ by Cope. They are the third and fourth premolars and the first and second molars.

On his page 53, Schlesinger mentions the lower tusk illustrated by Cope by his figures 8 and 8a; and Schlesinger regards this tusk as

¹⁴ Wheeler, U. S. Geogr. Sur. west 100th merid., pl. LXXI, figs. 1, 2.

demonstrating his view that Cope's species is identical with *G. leptodon*. That might be the case if he could be sure that the tusk belonged to the same species as Cope's type. The writer believes that it belonged to another species. The fragment is 220 mm. long. How much of the distal end is missing cannot be determined; it may be that it was but little longer or twice as long. The proximal end has the pulp cavity filled with sandstone. The greater diameter is 56 mm.; the shorter, 39 mm. Its section, as shown by Cope's figure, is wholly different from that of the tusk of Cope's type and from that of the symphysis figured by Leidy. On both the upper and lower faces there is a broad shallow groove or channel. It belonged to an animal evidently larger than *G. productum* and possibly one having a shorter jaw.

Dr. Schlesinger, on his pages 51 and 228, identified the tooth described by Leidy from California under the name *Mastodon obscurus* as identical with Schlesinger's "*forma subtapiroidea*." When the cast of that lower tooth, if lower it is, is placed alongside of the subtapiroid lower teeth of Schlesinger's plate VIII very distinct differences are observed. When the cast is compared with upper teeth of Schlesinger's subtapiroid form (his pl. IV, fig. 2; pl. VII, fig. 3) there is still less agreement, although the common possession of a pretrite cingulum is shown.

On his page 36, Dr. Schlesinger noted the fact that Gaudry had described a species, *Mastodon pyrenaicus*, (now regarded as a synonym of *G. leptodon*) which presented characters resembling those of *M. tapiroides*. Schlesinger concluded that this form *pyrenaicus* is probably a synonym of his *subtapiroideus*, in case the tusks should not exclude its union with *G. leptodon*. A remark or two are suggested. In nomenclatural parlance *subtapiroideus* would be a synonym of *pyrenaicus* not *vice versa*. Why should Schlesinger burden the literature with his new name before he had determined that the two forms are different? Why did he not give to Cope's *proavus* and Leidy's *obscurus* the benefit of the qualifying phrase which he used in referring to *pyrenaicus*?

In maintaining these objections to Schlesinger's views the writer does not deny that the animals in question are closely related, that *G. productum* may have descended from *G. leptodon*; but he believes that the first constitutes a form sufficiently different to be regarded as a species. As long as it is not demonstrated that the two are identical he does not see what is to be gained by insisting that they are identical. Cope's ideas regarding species may have been narrow, but possibly Schlesinger's may be thought by some to be somewhat too broad.